2/23/2001

Mr. J.S. Johnson
Attn: SURTASS LFA Sonar OEIS/EIS Program Manager
901 North Stuart Street, Suite 708
Arlington, VA 22203

Dear Mr. Johnson:

Thank you for sending a copy of the Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar. Since my comments to you on the Draft OEIS/EIS (O-26; Balcomb, November 12, 1999), I have had the unique opportunity to witness and study a mass stranding of whales and a dolphin caused by a US Naval Sonar Exercise in the Bahamas (Pirie, ltr. June 15, 2000). That incident unequivocally demonstrated the lethality of high-powered sonars, and it provided the opportunity to understand how sonar has been inadvertently killing whales in vast expanses of ocean around the world.

The killing is largely due to resonance phenomena in the whales cranial airspaces that are tearing apart delicate tissues around the brains and ears. This is an entirely separate issue from auditory thresholds and traumas that the Navy has fixated upon. In my earlier comments, I questioned whether there might be a problem with injurious resonance phenomena created by the sonar system described in your OEIS/EIS; but, now I have seen the problem and can attest to the fact that there is massive injury to whales caused by sonar. This is not an exaggerated statement, and I am reasonably sure that the Navy knows that. Please allow me to explain what happens to the whales.

Resonance, as engineers well know, can dramatically contribute to shear forces that can be quite damaging; wings tear off airplanes, bridges gallop, and buildings collapse, etc. due to unanticipated resonance phenomena which can afterwards be explained by simple physics and mechanics. I wondered about tissue damage caused by resonance, and I specifically asked what the Navy calculations for lung resonance frequencies of a beaked whale were at various depths. [You sidestepped my question by responding generically to my comment with response 4-4.15].

Subsequent to my asking you about specific resonant frequencies and depths, I found that in 1998 NATO and the US Naval Undersea Warfare Center had already calculated the resonance frequency of airspaces in Cuvier beaked whales (Ziphius cavirostris) to be about 290 Hz at 500 meters depth (page H2, SACLANTCEN M-133), which is almost precisely the middle frequency of LFA (100-500 Hz) described in your OEIS/EIS! That information is quite important, with specific reference to Technical Report 3 of your DOEIS/EIS, wherein there are several citations of Navy sponsored studies that clearly demonstrated vestibular dysfunction (eg. dizziness, vertigo) and lung hemorrhage, etc. in laboratory animals exposed to LFA at their lung resonance frequency.

In other words, the Navy has sufficient information available to know there is at least theoretically a very serious problem to whales from LFA for even brief periods of time. The scientific and medical literature contains numerous examples of hemorrhagic injuries and death occurring in humans when they are inadvertently exposed to loud sound, particularly at their lung (airspace) resonance frequency. Undoubtedly such damage could also be demonstrated as occurring to whales if they could be tested and did not sink to the bottom of the ocean when they die.

The NATO report I referred to for resonance calculations was concerning the mass stranding of at least twelve Cuvier's beaked whales in Greece on 12 May, 1996 coincident with a NATO acoustic trial employing both LFA (450-700 Hz) and mid-frequency sonar (2.8-3.3 kHz). Superficially, in reading that report one might wonder whether either frequency range caused the whales to strand in Greece, since neither matched the reported resonance frequency in that instance for Cuvier's beaked whales airspaces at an arbitrarily chosen 500 meters depth.

However, also in that NATO report there were formulae of Minnaert and Andreeva presented that indicated the resonance frequency of airspaces can be calculated, within acceptable limits, from their volumes. Lung (airspace) volumes vary individually, and they also vary with depth, hence their resonance will vary accordingly. Nonetheless, the Navy used the formulae, and so did I. You could, too.

In order to perform these airspace resonance calculations correctly, one must know or take into account the following:

a. Boyles Law PV=3Dconstant; therefore, lung (airspace) volume will decrease with increasing depth due to increasing pressure.

b. Lung (airspace) volume at the surface.

c. Functional anatomy of deep-diving beaked whales.

It is the volume of air in the individual pterygoid sacs and the laryngeal airspace, not the lungs, for which resonance should be calculated. Below about 100 meters depth virtually all of the air that was in the lungs at the surface is forced into laryngeal and cranial airspaces, wherein its volume continues to decrease with increasing depth until it has a total volume less than that of a football (compressed from, for example, a 100 liter lung full of air). The two largest of these remaining airspaces (pterygoid sacs or sinuses) are bilaterally adjacent to the earbones and the base of the brain (via the large foramen for the oversize VIII cranial nerve); and, their diminishing volume at depth is compensated for by retia mirabilia (a corpus cavernosum-like vascular network extending to the middle ear). [Envision the football-size airspace further squeezed to the size of a ping-pong ball with 1500 psi air pressure, now tucked between the ear bulla and the skull on each side of the head, thinly separated from a bag of blood next to it on the soft side.

Following the Navy's example and the formulae of Minnaert and Andreeva, the frequencies of LFA (and powerful mid-frequency sonars) precisely match these cranial airspace resonance frequencies in these whales at predictable depths where they normally forage (500-1500 meters). [Now envision rapidly compressing and decompressing the ping-pong ball many times per second (sound and sonar travels as compressions and decompressions of the medium through which it is passing) until ultimately the amplitude is exaggerated by resonance.] The result is both astonishing and bloody. Many whales died due to this sonar resonance in Greece and in the Bahamas. Unfortunately, the Greek mass stranding incident passed into relative obscurity because the SACLANTCEN Bioacoustics Panel missed the crucial point of matching resonance in critical airspaces; and, because suitable specimen materials were not collected for discovering the problem.

At least seven beaked whales died in the Bahamas stranding that witnessed; and, I had opportunity to examine four of the carcasses by necropsy. All of these whales that were examined evidenced similar lesions, i.e. hemorrhage in the acoustic regions of the cranium and mandible and in tissues adjacent to airspaces around the earbones (NMFS ltr. June 14, 2000). One fresh specimen that was examined by ultra high-resolution computerized tomography (UHR-CT) evidenced a subarachnoid hemorrhage (brain hemorrhage) with a direct path to the ear hemorrhage. This same specimen evidenced lung hemorrhage and laryngeal hemorrhage upon dissection. These hemorrhages are of the type of damage reported in laboratory animals exposed to LFA at lung resonance frequency, and they strongly corroborate the theoretical explanation of such injuries in these whales.

In order to approach this problem empirically, prepared an endocast of the pterygoid sac of one of the Cuvier's beaked whale specimens from the Bahamas incident and determined that its volume closely matched the calculated volume used for the resonance formulae beginning around 170 meters depth where it would resonate at 470-590 Hz (within LFA range). At greater depths the resonance frequency of this pterygoid sac would increase to around 3.5 kHz at 1400 meters. Because most of the hemorrhage observed was in tissues adjacent to the pterygoid sac at its most posterior end where it is enveloped by retia mirabilia in a unique cul-de-sac of sesamoid bone and dense earbone that keep this space open during the deepest part of a dive, consider the evidence compelling that resonance of this particular airspace is a real problem.

Again with respect to the Bahamas incident, I have read (Pirie ltr.) that the sonars employed were standard hull mounted and operating at 3.5 kHz @ 235 dB re 1uPa SL and 7.5 kHz @ 235 dB re 1uPa SL. What is important, of course, is the received level (RL) of these projected frequencies at the whales receiving location when first impacted by the sound. I have been told that the Bahamas situation may have been complicated by oceanographic conditions and other factors that could have resulted in a surface sound duct in which most of the acoustic energy was trapped; but, I also documented that the whales stranded over an area 200 kilometers across! In this case, if the Navy report of several surface ships using standard, hull-mounted sonar operating within normal mid-range frequencies, power outputs, and duty cycles is true; and, if within a range of 1000 meters from the ship in this surface duct, the sound level from the sonars dropped in intensity to less than 180 dB is also true; then, it is not possible that all of the whales that stranded over such a huge area experienced received levels (RL) of these sonars above the alleged safe limit of 180 dB (not enough ships; too large an area). I conclude that the whales in the Bahamas incident were adversely and lethally impacted by sonar pings at received levels well below the 180 dB re 1uPa considered safe for whales, and this was due to the aforementioned resonance problem. These pings were of much shorter duration (1/10th second) than the proposed LFA pings, I might add.

This sonar impact at received levels well below 180 dB is likewise well documented in the Greek incident reported in the NATO report SACLANTCEN M-133 (Annex G). The first whale to strand did so 40 km from the ship one hour after the acoustic trial commenced. If one takes into account how fast a beaked whale can swim (about 15 km per hour, maximum), it must have been at least 25 km from the ship when the first of its 238 four-second pings was transmitted! At that distance the RL was calculated by the Navy (NATO, Annex G) to be approximately 150 dB! The Bioacoustics Panel overlooked this important bit of evidence of received level for impact.

Therefore, based on two significant mass mortality events (Greece and the Bahamas) the body of evidence indicates that not only is resonance with LFA and sonar frequencies a problem for beaked whales, the sound pressure level of 180 dB RL is demonstrably not safe, and it is probably not safe for other cetaceans (two minke whales and a dolphin also stranded in the Bahamas incident). Aversion and/or physiological damage evidently and repeatedly occurs in beaked whales at levels of somewhere between 150 and 180 dB RL (probably nearer the former) of either low frequency or mid-frequency sonar signals in the whales normal habitat.

Clearly, the impact of high-powered rapid-rise acoustic energy (such as sonar), particularly at airspace resonance frequency, on these animals is occurring at significant distances well beyond the current mitigation distance (1-2.2 km) used by the Navy. These impact distances can be easily calculated, and they are more like 20 to 100 kilometers, and more well over the horizon of shipboard observers.

Cuvier's beaked whales were reasonably common in our field study area prior to the Bahamas incident; we had photo-identified about thirty-five of them, many repeatedly. We typically sighted small groups of these whales a dozen
or more times per year in any month of the year. But since the Bahamas sonar incident we have seen this species only once in an entire year, and that was a sighting of two previously unidentified whales (i.e., new arrivals to our study area) about two months after the sonar exercise. None of the whales that were rescued have been seen again. *In retrospect, it is probable that all Cuviers beaked whales in the region when the naval exercise commenced were killed by the sonar, whether or not they were returned to sea by well-wishers pushing them off the shore.* Considering the observed damage to the whales that stranded and died, and the short time period between stranding and death, the NMFS statement that the whales died from stranding is patently absurd. The whales that we observed swimming toward shore and stranding were only temporary survivors of an acoustic holocaust that can be likened to fishing with dynamite.

In summary, I consider the Navy's Final OEIS/EIS fails to justify the deployment of SURTASS/LFA with negligible or mitigable potential to harm marine mammals, therefore I recommend the No Action Alternative. In fact, there really is no Alternative 1- the Navy cannot reasonably mitigate the problem using visual, active acoustic or passive acoustic monitoring, nor can the Navy redesign the whales; at best it can only reconsider and perhaps redesign the SURTASS/LFA system. Considering that the facts of multiple whale deaths and their almost certain cause are now known to me, I
cannot legally or morally support any recommendation to deploy SURTASS/LFA as proposed, and I trust that will be your conclusion as well.

Sincerely,

Kenneth C. Balcomb, III
Whale Biologist
Cc: Office of Protected Species, NMFS
CNO OP95
US Marine Mammal Commission

Ocean Mammal Institute Letter

March 2000, Ken Balcomb discovered a whale dying in the water at his back doorstep. He soon discovered other whales dying in the area as well. He, along with the help of Diane Claridge and others, attempted to rescue several species of cetacean as they stranded in the Bahamas. Simultaneously, he recorded these events on video and created documentation
that has helped to support the evidence that whales are dying in direct coincidence to the use of Navy sonars.

We at the Ocean Mammal Institute acknowledge the importance of the information in the following letter written by Ken Balcomb to J.S. Johnson, SURTASS LFAS Program Manager, dated February 23, 2001. To ensure that all the key points Ken Balcomb expresses are understood by those outside of the scientific community, we have listed below the 7 most critical issues of the letter:

1.. As a result of an investigation of the stranding in the Mediterranean in 1995, correlated with NATO Low Frequency Active Sonar (LFAS) tests, NATO and the U.S. Navy have known the resonance frequency of airspaces in Cuvier's beaked whales since 1998, (page H2, SACLANTCEN M-133).

2.. The resonance frequency of these whales' airspaces almost precisely match the frequencies of LFAS and powerful mid-range sonars.

3.. When Cuvier's beaked whales are exposed to high intensity sonar at their airspace resonance frequency via LFAS or mid-range sonar can be painful and life threatening. Envision a football squeezed to the size of a ping-pong ball by air pressure alone. Now envision this ping -pong ball compressing and decompressing hundreds of times per second. Imagine this ping -pong ball located in your head, between your two ears. This is what the Cuvier's beaked whales experienced as a result of the Navy's sonar testing in the Bahamas in March 2000. Airspace resonance phenomena resulted in hemorrhaging which caused the stranding and deaths in the Bahamas.

4.. Evidence is clear that the whales in the Bahamas stranding in 2000 and the Mediterranean stranding in 1995 were exposed to high intensity sonars (LFAS in the Mediterranean and the Navy's standard mid-range sonar in the Bahamas) at received levels well below 180 dB, the sound level presumed to be "safe" by the Navy. In fact the whales in the Mediterranean stranding were exposed to a received level of 150 dB of LFAS according to calculations by the Navy (NATO, Annex G).

Therefore, based on two significant mass strandings and deaths (Greece in 1998 and the Bahamas in 2000) evidence indicates that not only is airspace resonance with LFAS and other sonar frequencies a problem for beaked whales, but also the sound pressure level of 180 dB received level is not safe, and is probably not safe for other cetaceans as well (two minke whales and a dolphin also stranded in the Bahamas).

5.. The Navy says they will not use LFAS if whales are seen in the area. Unfortunately, the lethal impact of this sonar, especially at airspace resonance frequency, can affect marine mammals who are 20-100 kilometers or more away from the deploying ship. Shipboard observers obviously could not see whales at these distances.

6.. Before the Bahamas stranding researchers sighted beaked whales a dozen or more times a year in the area. In the year after the Bahamas stranding they saw beaked whales only once and they were two previously unidentified whales who were probably new arrivals to the area.

7. Ken Balcomb believes it is probable that all Cuvier's beaked whales in the region were killed by the

naval sonar. Therefore, he concludes that LFAS cannot be deployed with only minimal harm to marine mammals and he cannot legally or morally support any recommendation to deploy LFAS as proposed.

There are two letters to send, one to your congressperson, and one to the National Marine Fisheries Service, who can approve or disapprove the implentation of LFAS into our oceans. If you have time, write a letter in your own words for even more impact. Please, please, do this today!!!! The future of our oceans depends on enough people speaking up to stop this deadly device.

Re: SURTASS LFA Sonar

Dear Congressperson:
I am writing to ask you to support immediate oversight hearings into the US Navy's antisubmarine warfare program, SURTASS LFA Sonar, particularly into the low frequency and midrange sonar impacts on marine life.

Please call for an investigation into the Navy ignoring the impacts of LFAS, including mass strandings and deaths of dolphins and whales where LFAS testing has taken place.

Please request an audit by the Government Accounting Office of the US Navy's low frequency active sonar program.
Please request that all funding for the low frequency active sonar be terminated. The two major reasons for terminating this program are the severe environmental damage LFAS inflicts on marine life and the availability of passive listening devices to achieve the same national security purpose (detection of silent submarines) without causing such destruction to the oceans.

I am extremely concerned about the effects of LFAS on our valuable ocean life. LFAS testings in Hawaii, Greece, and the Bahamas has had serious negative effects on the dolphin and whale populations. I oppose the use of LFAS anywhere and I hope you do too.

Thank you for your immediate attention to this matter.
Sincerely,

Donna Wieting, Chief;

Marine Mammal Conservation Division;

Office of Protected Resources;

National Marine Fisheries Service;

1315 East-West Highway; Silver Spring, MD 20910-3226

Fax number: 301-713-0376. (Please note: If this fax number is busy, please keep trying, or mail your lett

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Dear Ms. Wieting,

Please add my name to the list of people who urge you to rule against issuing a Letter of Authorization to the US Navy's SURTASS LFA program, which would allow the use of SURTASS LFA Sonar. The Navy contends that the impact from this technology would be "negligible." Please know that I subscribe to the belief that further information will reveal that the system is harmful to marine life and quite possibly to humans and to coastal communities.

I urge you to use caution in evaluating the Navy's information, which is scattered through volume after volume of supplemental reports two thick volumes of more than 1200 pages. And for all its size, this documentation is fraught with omissions and is deemed to be incomplete. The research done is more suitable to research and development objectives which seek to market a specific product. There is too much contradicting information for this documentation to be viewed as "scientific" or to support environmental goals.

So please consider the US Navy's report to be tainted with investment potential which supercedes environmental concerns. I urge you to be sensitive to the needs of citizens and communities, which ask about the sensibility of this potentially harmful and invasive technology. I ask you if you will not be hurting the fishing opportunities along our coastlines and I further question if allowing this damaging sound to enter our waters has the possibility of causing those adults and children who are in the water to be at risk.

Please know that the Navy is not in compliance with the Coastal Zone Management Act because there has not been a hearing with the California Coastal Commission which objects to the proposed, extreme and highly controversial technology. The US Navy has not complied with NEPA requirements because they spent in excess of 350 million dollars on a harmful program in an effort to make it look good. It should be evident that the US Navy was thereby wasting money on something before studying it. Much of the EIS is trying to mitigate the draft's miscalculations pertaining to habitat destruction and shoreline influences. The EIS seeks to justify excuses for environmental aggression. Please do not issue a letter of authorization for SURTASS LFA Sonar. Do not allow acoustic destruction of our oceans.

Best regards,